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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/708,863	11/08/2000	Christopher L. Aardahl	00-508	3003
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CATERPILLAR INC. 100 N.E. ADAMS STREET PATENT DEPT. PEORIA, IL 616296490			WACHTEL, ALEXIS A	
			ART UNIT	PAPER NUMBER
			1764	

DATE MAILED: 11/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/708,863

Applicant(s)

ABC

Examiner

Alexis Wachtel

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 08 November 2000.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 2-9-01; 4-11-02
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

***Detailed Action***

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,711,147 to Vogtlin et al and US 6,592,833 to Kharas and US 6,232,253 to Narula et al.

Vogtlin et al teaches with respects to claim 1: a method for nitrogen oxide (Nox) reduction in an oxygen rich exhaust comprising the steps of:

a) passing an oxygen rich exhaust through a non-thermal plasma thereby converting nitrogen oxide (NO) and hydrocarbons in the oxygen rich exhaust into nitrogen dioxide (NO<sub>2</sub>) and oxidized hydrocarbons and forming an intermediate exhaust (Fig.2);

b) passing the intermediate exhaust over at least one metal Y-alumina, thereby converting the NO<sub>2</sub> to nitrogen (N<sub>2</sub>) (78).

Regarding claim 1, Vogtlin et al as set forth above fails to teach that the Y-alumina has a pore volume of at least 1.0 cubic centimeters per gram. Narula teaches that sol-gel processing provides inorganic membranes with customized pore sizes (Col 3, lines 1-3). Since a greater pore volume translates into greater catalytic loading on the carrier, it would have been obvious to one of ordinary skill

to have employed a sol gel process in order to make a Y-alumina having the claimed pore volume since it is well recognized in the art that a greater loading of catalytic metal in the the Y-alumina carrier will translate into greater catalytic activity.

With respects to claim 2, Vogtlin et al as set forth above teaches the injection of fuel into NO<sub>x</sub> removal system which is downstream from the engine but fails to teach injecting an amount of at least one atomized hydrocarbon into the oxygen rich exhaust prior to passing the oxygen rich exhaust through the non-thermal plasma. Kharas teaches that hydrocarbon residence time can be manipulated by injecting hydrocarbons into the exhaust stream (Col 3, lines 55-56). In view of this teaching it would have been obvious to one of ordinary skill to have optimized the hydrocarbon residence time in the NO<sub>x</sub> removal system by introducing hydrocarbons into the exhaust stream as taught by Kharas.

Per claim 3: A method wherein step a) further comprises passing an oxygen rich exhaust having an oxygen content of equal to or greater than 4% through the non-thermal plasma (Fig.4).

With respects to claim 4, Vogtlin et al as set forth above fails to teach that the metal for doping Y-alumina is selected from the group consisting of indium, tin, gallium, silver, gold, copper, iron, cerium, and mixtures thereof. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can be include among other metals, gallium, indium and tin as well as mixtures thereof that are dispersed in supports such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with gallium, indium

and tin motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalysts.

With respects to claim 7, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with about 1 weight percent to about 10 weight percent indium. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can include indium that can be dispersed in a support such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with indium motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalyst. Additionally, since the quantity if indium used affects degree of NO<sub>x</sub> reduction, having selected the weight percent amount of indium used would have been determined through the process of routine experimentation.

With respects to claim 8, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with about 1 weight percent to about 20 weight percent tin. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can include tin that can be dispersed in a support such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with tin motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalyst. Additionally, since the quantity if tin used affects degree of NO<sub>x</sub> reduction, having selected the weight percent amount of indium used would have been determined through the process of routine experimentation.

Per claim 9: A method wherein step b) comprises a further step of doping the Y-alumina with about 1 weight percent to about 55 weight percent gallium.

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Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can include gallium that can be dispersed in a support such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with gallium motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalyst. Additionally, since the quantity of gallium used affects degree of NO<sub>x</sub> reduction, having selected the weight percent amount of gallium used would have been determined through the process of routine experimentation.

With respects to claim 9, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with about 1 weight percent to about 55 weight percent gallium. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can include gallium that can be dispersed in a support such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with gallium motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalyst. Additionally, since the quantity of tin used affects degree of NO<sub>x</sub> reduction, having selected the weight percent amount of gallium used would have been determined through the process of routine experimentation.

Per claim 11: A method wherein step a) further comprises a step of passing a diesel exhaust through the non-thermal plasma thereby converting the nitrogen oxide (NO) and hydrocarbons in the diesel exhaust into nitrogen dioxide (NO<sub>2</sub>) and oxidized hydrocarbons and forming an intermediate exhaust (Fig.2).

With respects to claim 5 Vogtlin et al and Kharas as set forth above fails to teach a further step of doping the Y-alumina with the metal by incorporating the metal into water for a gelation step as part of a sol gel method for formation of Y-alumina. With respects to claim 6, Vogtlin et al and Kharas as set forth above fails to teach doping the Y-alumina with the metal by bringing the Y-alumina into contact with a solution of the metal wherein the solution of the metal is present in an amount equal to or greater than the total pore volume of the Y-alumina. With respects to claim 10 Vogtlin et al and Kharas as set forth above fails to teach preparing the Y-alumina by a sol gel method. Narula teaches that sol-gel processing provides inorganic membranes with customized pore sizes (Col 3, lines 1-3). Narula et al also teaches a sol-gel processed inorganic alumina membrane with a transition metal loaded on the sol-gel processed membrane (Col 2, lines 49-53). In particular, a transition metal was loaded onto the membrane by dissolving a water soluble, transition metal containing salt in distilled water to form a transition metal containing solution; impregnating the transition metal containing solution on the membrane, where the membrane is sol-gel processed, which includes the following steps: mixing the membrane and the transition metal containing solution to form a mixture; stirring the mixture; evaporating water from the mixture to form a paste; drying the paste to form a dried sample; and calcining the dried sample. Transition metal as used herein includes copper, cobalt, nickel, chromium, iron, manganese, silver, zinc, calcium and compatible mixtures thereof; transition metal includes the elemental metal itself in addition to its metal oxide (Col 4, lines 1-13). The ratio of the amount of

transition metal to the weight of the sol-gel processed membrane is dependent on the desired transition metal loading on the sol-gel processed material. When the transition metal is silver, the amount of silver supported on the membrane is generally in the range of 1-8 weight percent of the overall weight. Generally, however, the amount of the transition metal is in the range of 1-20 weight percent of the overall weight (Col 4, lines 28-35). In view of this teaching it would have been obvious to have employed a sol-gel process to make the alumina support disclosed by Vogtlin et al and Kharas. One of ordinary skill would have been motivated by the desire to employ an alumina support manufacturing process that allows for customized pore sizes. Additionally, it would have been obvious to one of ordinary skill to have loaded the alumina support with an amount of metal at least equal to said alumina support's pore volume. One of ordinary skill would have been motivated by the desire to obtain a metal doped catalytic support with high activity.

Per claim 12: An exhaust treatment system for nitrogen oxide reduction in lean burn engines comprising:

a non-thermal plasma in an exhaust system that is adapted to receive an oxygen rich exhaust, said non-thermal plasma converting the nitrogen oxide (NO) and hydrocarbons in said oxygen rich exhaust into nitrogen dioxide (NO<sub>2</sub>) and oxidized hydrocarbons (Fig.2, Vogtlin et al);

a catalytic unit operably connected to said non-thermal plasma and adapted to receive said oxygen rich exhaust after said non-thermal plasma, said catalytic unit comprising Y-alumina (Fig.2, Vogtlin et al)



Regarding claims 12 and 16, Vogtlin et al as set forth above fails to teach that the Y-alumina has a pore volume of at least 1.0 cubic centimeters per gram. Narula teaches that sol-gel processing provides inorganic membranes with customized pore sizes (Col 3, lines 1-3). Since a greater pore volume translates into greater catalytic loading on the carrier, it would have been obvious to one of ordinary skill to have employed a sol gel process in order to make a Y-alumina having the claimed pore volume since it is well recognized in the art that a greater loading of catalytic metal in the the Y-alumina carrier will translate into greater catalytic activity.

Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with at least one metal, said metal comprises indium, tin, gallium, silver, gold, copper, cobalt, iron, cerium, or mixtures thereof. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can be include among other metals, gallium, indium and tin as well as mixtures thereof that are dispersed in supports such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with gallium, indium and tin motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalysts.

With respects to claim 13, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with about 1 weight percent to about 10 weight percent indium. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can include indium that can be dispersed in a support such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with indium motivated by the desire to exploit the NO<sub>x</sub>

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reducing properties of said catalyst. Additionally, since the quantity of indium used affects degree of NO<sub>x</sub> reduction, having selected the weight percent amount of indium used would have been determined through the process of routine experimentation.

With respects to claim 14, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with about 1 weight percent to about 20 weight percent tin. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can include tin that can be dispersed in a support such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with tin motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalyst. Additionally, since the quantity of tin used is recognized to affect the degree of NO<sub>x</sub> reduction, having selected the weight percent amount of tin used would have been determined through the process of routine experimentation.

With respects to claim 15, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with about 1 weight percent to about 55 weight percent indium. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can include indium that can be dispersed in a support such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with indium motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalyst. Additionally, since the quantity of indium used affects degree of NO<sub>x</sub> reduction, having selected the weight percent amount

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of indium used would have been determined through the process of routine experimentation.

With respects to claim 17, Vogtlin et al as set forth above fails to explicitly teach that the Y-alumina has a sulfate content of less than or equal to 0.1 weight percent. However, absent any disclosure that the Y-alumina has a sulfate incorporated into it, it is reasonable to assume that there is no sulfate in the Y-alumina.

With respects to claim 18, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with a metal comprising either 2.5 weight percent indium, 10 weight percent tin, 50 weight percent gallium, or mixtures comprising indium, tin and gallium. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can be include among other metals: gallium, indium and tin as well as mixtures thereof that are dispersed in supports such as alumina (Col 2 lines 46-65). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with gallium, indium and tin motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalysts. Additionally, since the quantities of indium, gallium, and tin used affects degree of NO<sub>x</sub> reduction, having selected the weight percent amount of indium used would have been determined through the process of routine experimentation.

Per claim 19. A system as recited in claim 12, wherein said Y-alumina has a surface area of at least 200 meters squared per gram (Col 9, line 11).


With respects to claim 20, Vogtlin et al as set forth above fails to teach that the Y-alumina is doped with mixtures of metals comprising indium, tin and

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gallium. Kharas teaches that a suitable lean NO<sub>x</sub> catalyst can be include among other metals, gallium, indium and tin as well as mixtures thereof that are dispersed in supports such as alumina (Col 2 lines 46-65, Vogtlin). In view of this teaching it would have been obvious to one of ordinary skill to have doped the Y-alumina with gallium, indium and tin motivated by the desire to exploit the NO<sub>x</sub> reducing properties of said catalysts.

### **Conclusion**

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alex Wachtel whose telephone number is 571-272-1455. The examiner can normally be reached on 10:30am to 6:30pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Glenn Caldarola, can be reached at (571)-272-1444. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Glenn Caldarola  
Supervisory Patent Examiner  
Technology Center 1700